PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21H 15/00, D01D 5/42 | A1

(11) International Publication Number: WO 95/09947

(43) International Publication Date: 13 April 1995 (13.04.95)

(21) International Application Number: PCT/GB94/02123

(22) International Filing Date: 29 September 1994 (29.09.94)

(30) Priority Data:
9320365.1 2 October 1993 (02.10.93) GB

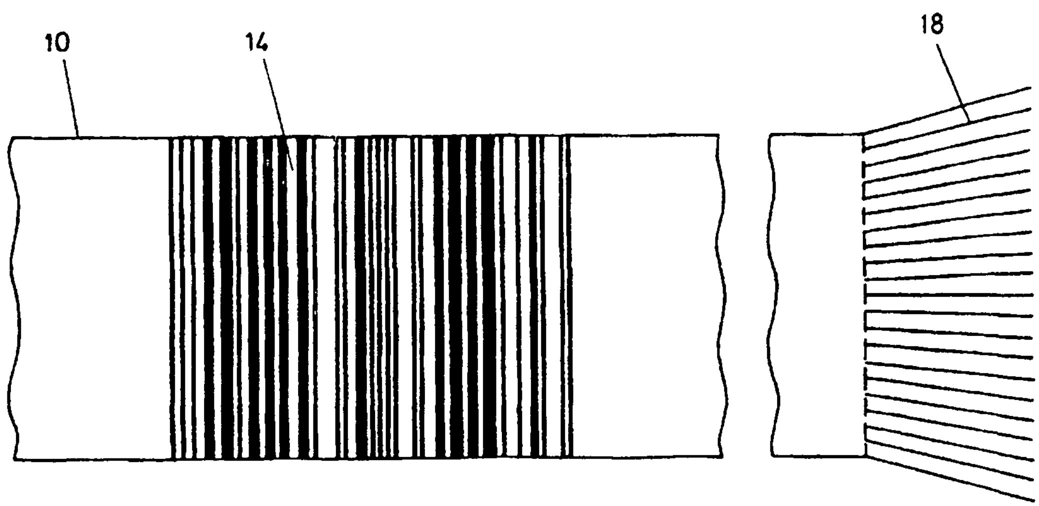
(71)(72) Applicants and Inventors: ATHEY, Graham [GB/GB]; Unit A13, Treforest Industrial Estate, Pontypridd, Mid Glamorgan CF37 5UA (GB). ZORAB, James [GB/GB]; Unit A13, Treforest Industrial Estate, Pontypridd, Mid Glamorgan CF37 5UA (GB).

(74) Agents: BRANDON, Paul, Laurence et al.; Appleyard Lees, 15 Clare Road, Halifax, West Yorkshire HX1 2HY (GB).

(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SIGNATURE FILAMENTS AND SECURITY PAPERS



(57) Abstract

The invention is concerned with the production of filaments or fibres each of which carries a recognisable "signature" (encoding). These filaments or fibres are produced by taking a film (preferably a plastics film) applying a code directly onto the film across the effective width of the film and then dividing the film substantially at right angles to the code into longitudinal filaments, so that the encoding is then present in each of the filament in exactly the same "signature" as in the code applied to the film.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgystan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo			SE	Sweden
CH	Switzerland	KR	Republic of Korea	SI	Slovenia
CI	Côte d'Ivoire	KZ	Kazakhstan	SK	Slovakia
CM	Cameroon	LI	Liechtenstein	SN	Senegal
CN	China	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
CZ	Czech Republic	LV	Latvia	TJ	Tajikistan
DE	Germany	MC	Monaco	TT	Trinidad and Tobago
DK	Denmark	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali	UZ	Uzbekistan
FR	France	MN	Mongolia	VN	Viet Nam
GA	Gabon				

SIGNATURE FILAMENTS AND SECURITY PAPERS

This invention relates to filaments or fibres which are treated to give them a recognisable "signature" (encoding) and more particularly, a signature which is machine-readable. The invention is realised in both the method of producing the filaments or fibres and in the filaments or fibres themselves.

Fibres having a machine-readable signature can be used, for example, to identify security papers, such as paper used for currency.

According to a first aspect of the invention, a method of manufacturing an encoded filament or fibre comprises: providing a film, applying a bar code directly onto the film across the effective width of the film, and then dividing the film substantially at right angles to the bar code into longitudinal filaments. It will be appreciated that it is not feasible to apply a bar code to a very narrow filament or fibre, but a bar code can be readily applied across the effective width of a film, and when the film is divided longitudinally, each of the strips or filaments so produced has the bar code applied to it. Even if the filaments are narrow enough to constitute fibres, each of those fibres will still carry the bar code, in very narrow form, and hence has the same "signature" or encoding as that applied to the film.

The film is preferably made of plastics material. Preferred materials include polyolefin, polyvinylchloride, polyester, polyamide, polyethersulphone, or polyetheretherketone (PEEK). A preferred polymer is polyolefin, especially a propylene polymer (which may be a homopolymer or an ethylene-propylene co-polymer with a

minor proportion of ethylene). The polyolefin is preferably polypropylene with a melt flow index of approximately 8 to 10 grammes per ten minutes, according to ASTM D1238.

According to a preferred feature of the invention, the film is divided longitudinally by fibrillation. If relatively wide filaments (say, over 1 mm in width) are required, it might be possible to employ slitters, but where the requirement is for narrower filaments, which can properly be described as fibres, then slitters are not suitable, but fibrillation can be used.

The deformation in the fibrillation unit may be twisting (for example, as described in British Patent Specification 1 040 663) or surface striation (for example, as described in "Fibre Technology: From Film to Fibre" by Hans A. Krassig, published by Dekker (1984)). Such surface striation typically involves passing the film under tension against needles or pins provided on a rotating roller, to cause rupture of the film longitudinally (in the machine direction), but without lateral separation or splitting until after the film has passed downstream of the roller. Such fibrillation is well known for polymer films where the film is fed in a continuous production run from the extruder to the fibrillation unit and it is one of the perceived advantages of the fibrillation process that it can be operated as an integral part of a continuous operation.

The fibrillation process causes the film to break up into long parallel filaments. In practice these long filaments may be cut to a "staple" length longer than the bar code repeat. It will also be appreciated that the film can be fed continuously past a bar code applicator, the

arrangement providing repeats of the bar code along the length of the film.

According to another preferred feature of the invention, the two colour effect required to produce the code bars and spaces is not readily visible to the naked eye. If the fibres produced by the invention are of small size, then the bar code will be difficult to detect with the naked eye in any event. (By way of illustration, 20 microns width will give a fibre approximately 5 decitex.) However, it is preferred that at least one of the two colours is outside the visible spectrum, and in the preferred method, the said one colour is fluorescent. In practice, it may only be necessary to apply one colour, since the other colour may be the natural colour of the film.

The use of encoding not visible to the naked eye is particularly advantageous in security paper, for example, because it ensures that the presence of the fibre cannot be detected without special reading equipment. However, whilst it is well known to incorporate a fluorescent filament in currency notes, so that the presence or absence of the filament can be recognised merely by irradiating the note with ultraviolet light, the present invention provides the additional advantage that significant data, such as alphanumeric data can be stored on the encoded fibre or filament.

It has also been found that the use of a fluorescent coding presents the advantage, additional to that of being invisible to the naked eye, that it produces a greater contrast with the natural colour of the film or any ordinary film colouring, than would be produced by an applied colour code in the visible spectrum. This

enhanced contrast value occurs particularly if a laser type bar code reader capable of reading a bar code of very small width, such as that on a fibre, is employed.

According to a second aspect of the invention, an encoded fibre comprises a plastics fibre, to which has been applied a bar code, in which the bars are substantially at right angles to the length of the fibre. The fibres in accordance with this second aspect of the invention may be manufactured in accordance with any of the preferred features of the first aspect of the invention.

According to a third aspect of the invention, a security paper (which expression is intended to include currency paper) includes fibres made in accordance with the first aspect of the invention. Preferably the fibres are incorporated in the paper in a random fashion by blending them into an aqueous slurry during the paper making process. An advantage of this aspect of the invention is that not only is it possible to verify the legitimacy of the paper, it is also possible to encode alphanumeric data on the fibres and hence in the security paper.

It is a disadvantage of printing a bar code using the conventional black bars, that when the fibre is incorporated in say a paper, the bar print interferes with any other printing subsequently applied to the paper. However, the fluorescent coding is not subject to this disadvantage. The fluorescent bars have a higher profile over subsequent printed matter than ink printed bars.

The invention will be better understood from the following description of one method of manufacturing encoded "signature" fibres and the production of security paper including the fibres, which is given here by way of

example only, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic elevation of the flow path of a continuous film, and

Figure 2 is a plan view of the film shown in Figure 1.

In this specific example, signature fibres are to be used in the manufacture of security paper such as that used for currency. The starting material, however, is a film 10 of polypropylene with a melt flow index of approximately 8 to 10 grammes per ten minutes according to ASTM D1238. The polypropylene film is extruded through an oblong die (not shown) water quenched, and then stretched in the direction of the extrusion machine to a ratio of between 4:1 and 10:1 using hot ovens to soften the film during the process. The resulting film 10 can typically have a thickness of from 5 micrometers up to 100 micrometers, but in the specific example, the thickness of the film is about 25 micrometers. The film width may be up to 2.2 metres.

The extrusion machine and hot ovens are not illustrated in the diagrammatic drawings, as these are conventional.

The film then passes a bar code applicator 12, which may for instance take the form of a drum or formed character printer, or an electrostatic printer. The printer 12 produces a bar code 14 on the top surface of the film 10, and as is illustrated in Figure 2, the bars of the code extend across the full width of the film, that is to say the bars are at right angles to the length of the film and to the direction of motion of the film. The spaces

between the bars are provided by the natural colour of the film 10, so that it is only necessary to apply the bars themselves. Although these bars have been clearly shown at 14 in Figure 2, in order to illustrate the invention, in practice, the applicator 12 is arranged to apply the bars in the form of fluorescent paint, so that they would not be visible to the naked eye, unless eradiated with ultraviolet light.

Now, although to the naked eye there is no or no substantial contrast between the colouring of the spaces and the bars, certain types of machine reader are well adapted to read a bar code in which the bars are of fluorescent paint, and indeed in the case of a laser-type bar code reader, for instance, the contrast between the natural colouring of the film and fluorescent paint is higher than the contrast between the film colouring and ordinary visible ink. Thus, one of the advantages of using the fluorescent paint is that it gives this higher contrast for machine reading.

Beyond the position of the applicator, the film passes over a pinned fibrillation drum 16, the pins of which engage with the undersurface of the film 10 and cause the film to be striated but not split. Downstream of the fibrillation roller 16, the film passes a stretch breaking station (not shown), at which the film divides into individual fibres indicated diagrammatically at 18. These fibres form a tow, which can be collected in a can coiler (not shown). It will be appreciated that the fibrils produced by this method have essentially parallel faces, formed out of the top and bottom surfaces of the original film, and in this respect, they differ from circular cross-section fibres conventionally used in the textile industry.

From the can coiler, the filamentary tow can be taken to textile opening machinery, such as a carding machine, which will produce further fibrillation, thus reducing the cross-sectional dimensions of the fibrils, and will also result in stapling the fibres. However, the tow could be subjected to a stapling operation as an alternative to or prior to the textile opening process.

Each of the fibres will carry the bar code, because the fibres extend generally lengthwise of the film to which the bar code is applied. Of course, since the fibres are of very small width, the "bars" are virtually reduced to dots, but the width of the "bars" will be retained in the fibres, and hence the encoding will be similarly retained. It is, of course, necessary to read this coding on a machine which is adapted to read off a very short "length" bar code. It is also important that the stapling process should be such that over the great majority of the stapled fibres, at least one repeat of the entire bar code is present.

In the manufacture of security paper or currency paper, fibres produced as described above are introduced into the aqueous slurry during the paper making process. The encoded fibres may constitute 1% or less of the fibrous material included in the slurry, and as a result of the mixing into the slurry, the fibres are in a random but relatively homogenous distribution throughout the paper which is produced from the slurry in a conventional paper making machine. It will be appreciated that since the bars of the code are formed of fluorescent paint, they are not visible in the security paper. Hence, by ordinary visual inspection, it is not possible to detect their presence. However, if the paper is passed under ultraviolet light, the bar coded filaments will radiate

the light, and their presence will be apparent. This provides the ordinary security effect. Beyond that, however, if the paper is passed under a bar code reader of a type which is adapted to read very short bar lengths, then the code can be read off from any of the randomly arranged fibres which extends predominantly in a longitudinal direction. Hence, alphanumeric data incorporated in the bar code can be read off from the security paper itself.

CLAIMS

1. A method of manufacturing an encoded filament or fibre comprising the steps of : providing a film, applying a code directly onto the film across the effective width of the film, and then dividing the effective width of the film substantially at right angles to the code into longitudinal filaments.

2. A method of manufacturing an encoded filament or fibre as claimed in Claim 1, in which the film is made of plastics material.

3. A method of manufacturing an encoded filament or fibre as claimed in Claim 2, in which the film is made of one of : polyolefin, polyvinylchloride, polyester, polyamide, polyethersulphone, or polyetheretherketone (PEEK).

4. A method of manufacturing an encoded filament or film as claimed in Claim 3, in which the film is made of propylene polymer.

5. A method of manufacturing an encoded filament or fibre as claimed in Claim 2, in which the film is a homopolymer or an ethylene-propylene co-polymer with a minor proportion of ethylene.

6. A method of manufacturing an encoded filament or fibre as claimed in Claim 3, in which the polyolefin is polypropylene with a melt flow index of approximately 2 to 10 grammes per ten minutes, according to ASTM D1238.

7. A method of manufacturing an encoded filament or fibre as claimed in any one of Claims 1 to 6, in which the film is divided longitudinally by fibrillation.

8. A method of manufacturing an encoded filament or fibre as claimed in Claim 7, in which the deformation in the fibrillation unit comprises twisting or surface striation.

9. A method of manufacturing an encoded filament or fibre as claimed in Claim 8, in which the surface striation comprises passing the film under tension against needles or pins provided on a rotating roller, to cause rupture of the film longitudinally (in the machine direction), but without lateral separation or splitting until after the film has passed downstream of the roller.

10. A method of manufacturing an encoded filament or fibre as claimed in any one of Claims 7 to 9, in which the long filaments produced by the fibrillation process are cut to a "staple" length longer than the bar code repeat.

11. A method of manufacturing an encoded filament or fibre as claimed in any one of Claims 1 to 10, in which the two colour effect required to produce the code bars and spaces is not readily visible to the naked eye.

12. A method of manufacturing an encoded filament or fibre as claimed in Claim 11, in which at least one of the two colours is outside the visible spectrum.

13. A method of manufacturing an encoded filament or fibre as claimed in Claim 12, in which the said at least one colour is fluorescent.

14. An encoded fibre comprising a plastics fibre, to which has been applied a bar code, in which the bars are substantially at right angles to the length of the fibre.

15. An encoded fibre as claimed in Claim 14, in which the fibres are manufactured in accordance with any one of Claims 1 to 13.

16. A security paper including fibres made in accordance with any one of Claims 1 to 13 or comprising fibres in accordance with Claim 14 or Claim 15.

17. A security paper as claimed in Claim 16, in which the fibres are incorporated in the paper in a random fashion by blending them into an aqueous slurry during the paper making process.

18. An encoded fibre produced by the method of any one of Claims 1 to 13.

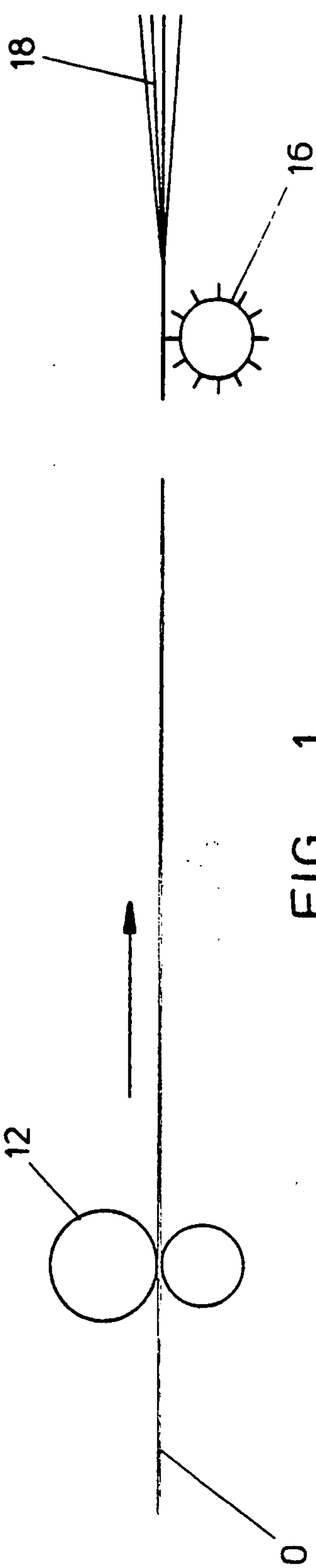


FIG. 1

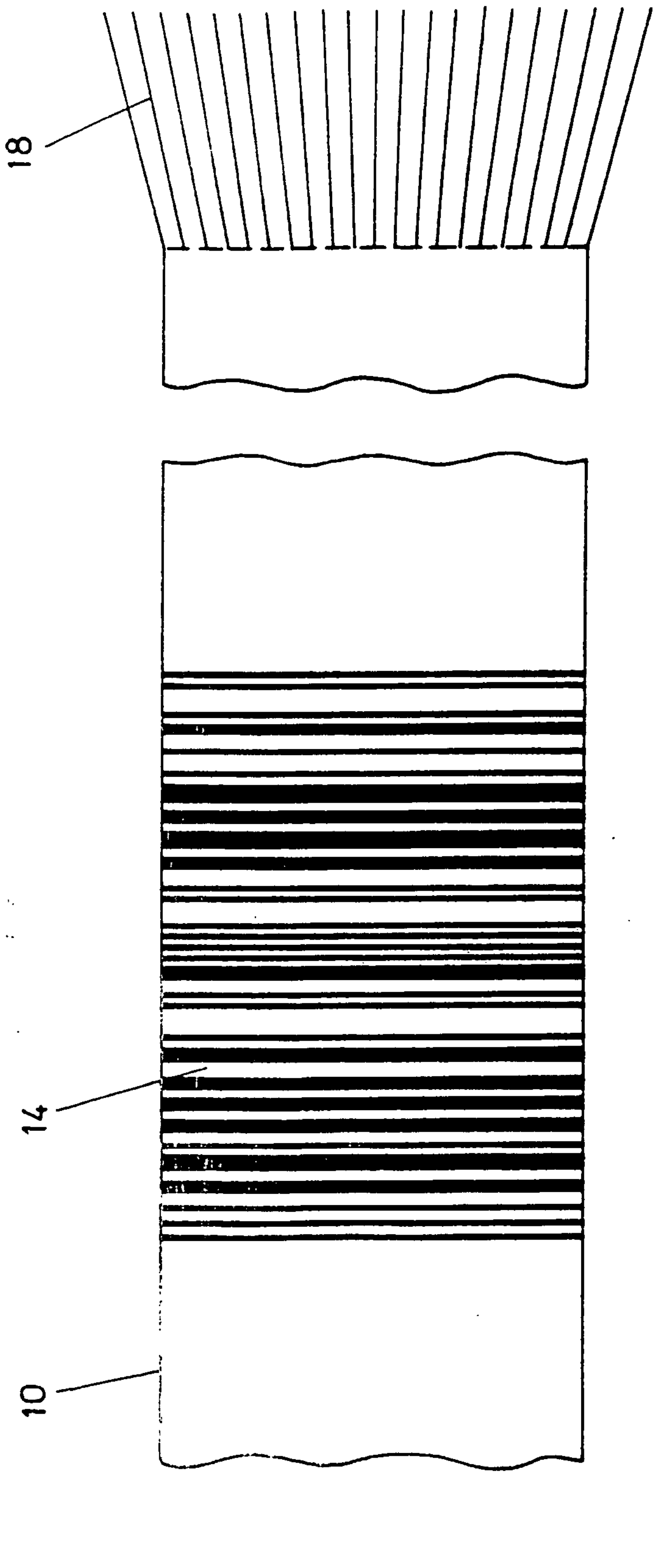


FIG. 2

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21H15/00 D01D5/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21H D01D B42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,92 08826 (JAMES ZORAB ET AL.) 29 May 1992	
A	EP,A,0 310 707 (MANTEGAZZA ANTONIO ARTI GRAFICHE S.R.L.) 12 April 1989	
A	EP,A,0 490 412 (GAO GESELLSCHAFT FUR AUTOMATION UND ORGANISATION MBH) 17 June 1992	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 February 1995	08.02.95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Tarrida Torrell, J

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9208826	29-05-92	AU-A- 8918091	11-06-92
EP-A-0310707	12-04-89	DE-A- 3781894	29-10-92
EP-A-0490412	17-06-92	DE-A- 3609090	24-09-87
		DE-A- 3784257	01-04-93
		EP-A,B 0238043	23-09-87
		US-A- 4892336	09-01-90